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Reducing health inequalities in England: does the demise of NHS Stop Smoking Services matter? Analysis of mandatory monitoring data

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Abstract

Background Tobacco smoking is a key cause of mortality, morbidity and health inequalities. The unprecedented English health inequalities strategy (1999-2010) sought to reduce health inequalities, by, in part, instigating NHS Stop Smoking Services (SSS), initially targeted in deprived 'Spearhead' localities. Performance of SSS is assessed here in light of its role supporting the strategy, which evidence suggests achieved a reduction in health inequalities.

Methods SSS enrolment and four-week quits in Spearhead and non-Spearhead localities were compared during and after the strategy period, using regression models and routine monitoring data. Changes in SSS expenditure were estimated.

Results After similar increases in enrolment and quits between Spearhead and other localities between 2003/4 and 2008/9, SSS in Spearhead localities experienced a twofold better rate of improvement in enrolment and quit performance over the four years to 2011/12. Since 2011/12, SSS have dramatically reduced, and expenditure had fallen by half in Spearhead localities by 2016/17.

Conclusions SSS, particularly in Spearhead localities, were expanded up to 2011/12, and this broadly coincides with the reduction in health inequalities. This suggests that although SSS did not achieve the scale anticipated, they have important potential, and the current demise of SSS should not be tolerated.

Introduction

The importance of tobacco smoking as a public health issue has been long appreciated, both as the largest cause of premature death and preventable illness in the UK,[1] and for contributing to health inequalities,[2] accounting for about half of the difference in life expectancy across the income group range.[3] The New Labour Government sought to achieve a 'sustained drive to reduce inequalities in health' by instigating a large-scale programme which would 'integrate national targets with local innovation'.[4] Spanning government departments, this English health inequalities strategy committed over £20bn:[4-6] announced in 2001, and subsequently refined, a key target was to reduce the gap in life expectancy by at least 10% between the local authorities with the worst measures relating to deprivation and health (known as the Spearhead Group) and the other local authorities in England.[7,8] The focus for health interventions was on smoking cessation, along with blood pressure and cholesterol control.[8] In contrast to contemporary assessments which suggested that the target to reduce the gap in life expectancy by at least 10% by 2010 was not being met,[5,7,9] the recent study by Barr et al[6] found that the target was achieved. Moreover, since the subsequent Coalition Government's abandonment of the health inequalities strategy, inequalities have started to widen.[6]

NHS Stop Smoking Services (SSS) were first introduced in 'areas of greatest need' in 1999/00, before national rollout from 2000/01.[2,10] From 2003/4, primary care trusts (PCTs) became responsible for commissioning SSS, which typically comprise behavioural support and pharmacotherapy over a period of weeks to help the smoker once they commit to stop smoking on or before a particular date.[11, 12] Economic evidence indicates that these interventions are effective and cost effective.[11, 13] National targets were initially set for the number of self-reported quits at four weeks.[14-15]

SSS are a key component of a wider approach to tobacco control.[2, 16-18] Evaluating the impact of SSS in Spearhead and non-Spearhead localities using routinely collected data is therefore important to inform national public health policy on tobacco control and health inequalities.[18] This study makes an important contribution to this aim.

Methods

Setting and data

The analysis used annual mandatory monitoring data on NHS SSS for the 17 years 2000/1 to 2016/17 published by NHS Digital, which is part of the Government Statistical Service.[19] The earliest data reported at locality level were from 2003/4, when the then PCTs became responsible for commissioning SSS and reporting SSS activity. PCT-level data to 2007/8 included self-reported quits at four weeks, defined as a treated smoker self-reporting continuous abstinence from smoking from day 14 post-quit date, whose quit status within 25 to 42 days of the quit date has been assessed (either face-to-face or by telephone, text, email or postal questionnaire) [20,21]. From 2008/9, the PCT-level data also included self-reported quits verified by carbon monoxide (CO) testing. The data report activity which would include each enrolment and 4-week outcome for individual smokers accessing SSS more than once in a single year. Annual best practice guidance on SSS data collection and reporting have been published since 2001/2, [22, 23] and in 2008/9 arrangements for improving data quality including an exception reporting regime were implemented.[24] Sensitivity analysis on quits was undertaken using an estimated number of quits measure, based on both self-reported and CO-verified quits, for which the calculation method is reported in the Appendix.

Locality-level data on the adult population, defined as those aged 16 years and over, were obtained from the office of national statistics (ONS) mid-year population estimates.[25-27] The geographical locality data on SSS and population estimates were mapped from 303 PCTs in 2003/4 to 152 PCTs in post-2006 configurations, to 152 local authorities from 2013/14. For example, Birmingham locality was represented by 4 PCTs from 2003/4, 3 PCTs in post-2006 configurations, and 1 city council from 2013/14. This process generated 138 localities, 59 of which were defined as Spearhead localities, being either completely or predominantly in the original Spearhead Group.[28,29] The remaining 79 non-Spearhead localities cover the rest of England.

Data on estimates of SSS expenditure, excluding pharmacotherapies costs, are reported in 2016/17 prices, based on an inflation index.[30,31] These data are available from [10] for 2000/1 and from the national returns[19] from 2001/2 at national level and locality level from 2010/11. Since 2013/14, some local authorities have not submitted expenditure data for the national returns, which has resulted in some of the 138 groups being omitted from the estimates of expenditure (see Appendix Table A1). Ethics approval was not required for using data published by the NHS and the ONS.[19, 25-27]

Outcome measures

To assess the performance of NHS SSS in light of the health inequalities strategy, change over time in outcome measures relating to SSS are compared between Spearhead localities and non-Spearhead

localities. The main outcome measures are the number of 1) smokers enrolled per 1,000 adult population, and 2) self-reported quits at four weeks per 1,000 adult population.

Secondary outcome measures are 3) self-reported quits at four weeks as a percentage of smokers enrolled in SSS (known as the 'quit-rate'), 4) estimated quits at four weeks per 1,000 adult population, and the number of CO-verified quits 5) per 1,000 adult population, 6) as a percentage of enrolled smokers, 7) as a percentage of self-reported quits.

The expenditure on SSS per head of adult population and the cost per self-reported quit at four weeks were estimated. Expenditure on SSS per adult head of population was estimated for Spearhead and non-Spearhead localities from 2010/11 using locality-level data which were first published in 2010/11. For the purpose of estimating 2009/10 expenditure for Spearhead and non-Spearhead localities, national data on expenditure were allocated to Spearhead and non-Spearhead localities in the ratio experienced in 2010/11. For those localities which did not report cost data from 2014/15, but reported SSS activity data, costs were estimated using the annual average cost per head of adult population for Spearhead and non-Spearhead localities.

Expenditure on SSS does not include the cost of pharmacotherapies issued as part of the services, which includes Nicotine Replacement Therapy (NRT), Bupropion (Zyban) and Varenicline (Champix). National data on pharmacotherapies expenditure were allocated to Spearhead and non-Spearhead localities in the ratio found for SSS expenditure in each year.

Statistical analysis

Mixed effects Poisson regression models were used to compare performance of Spearhead and non-Spearhead localities. For each outcome measure, the analysis determined whether the rate of change over time was significantly different in the Spearhead localities compared to non-Spearhead localities. The models accounted for clustering effects, with repeated measures nested within localities (n = 138). Localities had random intercept and slope terms. The response variable was an outcome measure (e.g. the number of enrolled smokers), with an exposure variable reflecting the area of opportunity (e.g. adult population). The model had three covariates—Spearhead locality (yes/no), years (continuous) and their interaction. The hypothesis of interest (i.e. "effect-size") was represented by the interaction term (rate of change of the incidence rate ratio). If the interaction term was significantly greater than 1 then we can conclude that the Spearhead-localities had a higher rate of change than non-Spearhead localities. Statistical significance was set at 5%, and the modelling was undertaken in Stata 15.[32] The model was run separately over four time periods. The period 2003/4 to 2011/12 covers the nine years of growth in SSS for which some locality-level

data were published. This period was also divided into two; 2003/4 to 2008/9, and 2008/9 to 2011/12. The latter period uses data that were first published in 2008/9, and more broadly corresponds to the period in which more emphasis was placed on addressing the health inequalities strategy in Spearhead localities, and the period in which the gap in life expectancy reduced.[6] The period 2011/12 to 2016/17 covers the period in which SSS activity has declined.

Results

Enrolment

The number of smokers per 1,000 adult population enrolled in SSS increased between its national start in 2000/1 and 2011/12, and then reduced each year to 2016/17 (Figure 1). Locality-level data were first published in 2003/4, and by then on average 11.6 smokers per 1,000 adult population in Spearhead localities were enrolled in SSS compared to 7.5 in other localities (Figure 1). Between 2003/4 and 2011/12, the average increase per year in enrolment in Spearhead localities was 7.5% compared to 6.4% in non-Spearhead localities (Table 1). Expressed as a ratio of rates, the difference was not statistically significant (p=0.12) (Table 1 and Appendix Table A2). Between 2011/12 and 2016/17, Spearhead and non-Spearhead localities experienced falls in this measure of enrolment of 18.9% and 17.4%, respectively, and the difference was not significant (p=0.18) (Table 1, Table A2).

Figure 1 Stop Smoking Services: smoker enrolment and self-reported 4-week quits

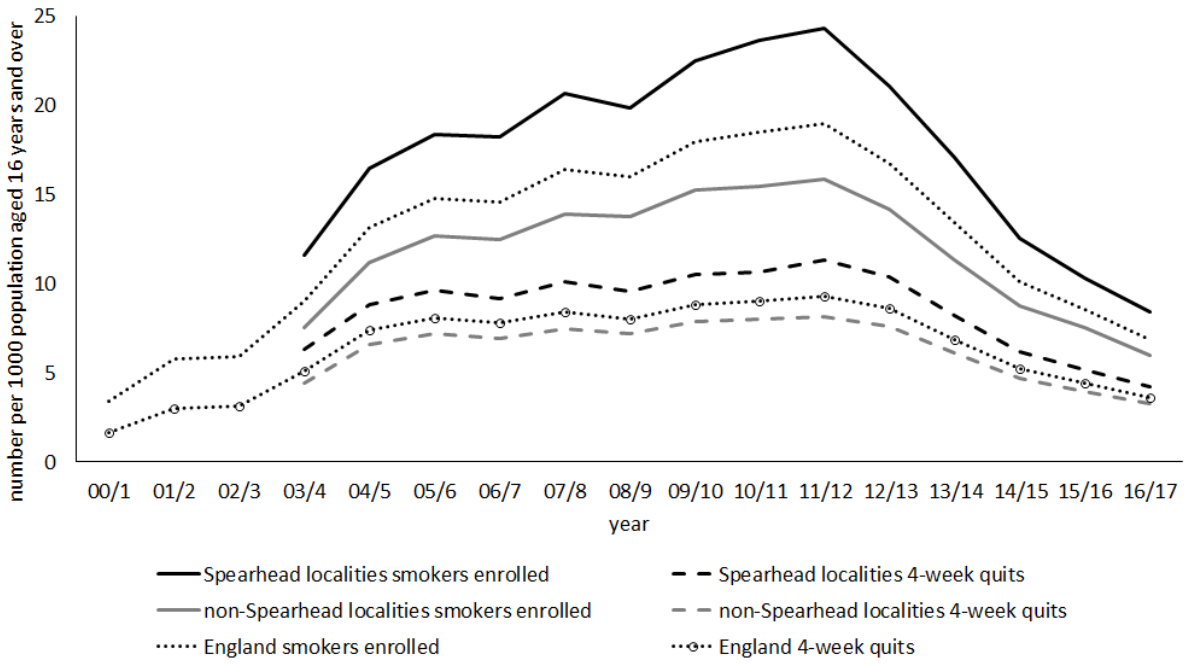


Table 1 Spearhead and non-Spearhead localities, changes over time: summary model findings

measure and period	all persons mean % change per year			males mean % change per year			females mean % change per year		
	Spearhead	non-Spearhead		Spearhead	non-Spearhead		Spearhead	non-Spearhead	
smokers enrolled in SSS per 1,000 adult population [b]									
2003/4 to 2011/12	7.5	6.4							
2011/12 to 2016/17[a]	-18.9	-17.4		-19.1	-17.8		-18.8	-17.1	
2003/4 to 2008/9	10.1	9.8							
2008/9 to 2011/12	6.6	3.1	*	6.9	3.1	*	6.3	3.1	*
self-reported quits per 1,000 adult population [b]									
2003/4 to 2011/12	5.1	4.9							
2011/12 to 2016/17[a]	-18.7	-17.8		-18.8	-18.1		-18.6	-17.5	
2003/4 to 2008/9	6.9	7.5							
2008/9 to 2011/12	6.0	3.3	*	6.6	3.4	*	5.3	3.3	
estimated quits per 1,000 adult population [c]									
2008/9 to 2011/12	6.3	3.1	*	6.9	3.8	*	5.6	3.6	
2011/12 to 2016/17[a]	-18.6	-17.8		-18.7	-18.2		-18.6	-17.5	
CO-verified quits per 1,000 adult population [c]									
2008/9 to 2011/12	9.6	6.5		10.4	6.7		8.7	6.3	
2011/12 to 2016/17[a]	-18.0	-17.8		-17.6	-17.8		-17.8	-17.4	
self-reported quits as a percentage of enrolled smokers [b]									
2003/4 to 2011/12	-2.4	-1.6	*						
2011/12 to 2016/17[a]	0.2	0.6		-0.4	-0.7		-0.9	-1.1	
2003/4 to 2008/9	-3.3	-2.3							
2008/9 to 2011/12	-0.6	0.3		0.2	-0.5		0.2	-0.4	
CO-verified quits as a percentage of enrolled smokers [c]									
2008/9 to 2011/12	2.8	3.4		3.2	3.5		2.2	3.0	
2011/12 to 2016/17[a]	1.5	-0.2		1.7	-0.3		1.2	-0.5	
CO-verified quits as a percentage of self-reported quits [c]									
2008/9 to 2011/12	3.3	3.0		3.4	3.1		3.0	2.8	
2011/12 to 2016/17[a]	1.3	0.2		1.5	0.3		1.0	-0.1	

SSS = Stop Smoking Services

* p <0.05 for incidence rate ratio

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis

[b] gender-specific data for this measure were not published at locality-level before 2008/9
[c] data for this measure were not published before 2008/9

However, after similar experience between 2003/4 and 2008/9, between 2008/9 and 2011/12, the Spearhead localities experienced an increase of 6.6% per year in enrolment, compared to an increase of 3.1% in non-Spearhead localities, and the difference was significant (p=0.01) (Table 1, Table A2). This change in enrolment in Spearhead localities compared to non-Spearhead localities was significant for both males and females (Table 1, Table A2).

In each comparison period, the Spearhead localities had higher baseline enrolment performance compared to non-Spearhead localities (Table A2).

Four-week quits

Self-reported quits

The experience of self-reported quits per 1,000 adult population was similar to that for enrolment (Figure 1, Table 1, Table A3). Comparing Spearhead and non-Spearhead localities over the four years to 2011/12, the average increase per year in self-reported quits was 6.0% and 3.3%, respectively, and the difference was significant (p<0.05) (Table 1, Table A3). This comparative change in self-reported quits was significant for males (p=0.02), but not females (p=0.12) (Table 1, Table A3). The Spearhead localities baseline performance in 2008/9 was significantly higher for females (p<0.01), but not for males (p=0.44) (Table 1, Table A3).

Estimated quits

Performance measured using estimated quits per 1,000 adult population, which adjusts for the over-reporting of self-reported quits not verified by CO-testing, also shows that over the four years to 2011/12, Spearhead localities experienced an average increase per year in estimated quits of 6.3% compared to 3.1% in non-Spearhead localities, and the difference was significant (p<0.05) (Table 1, Table A4). This comparative change in estimated quits was significant for males (p=0.02), but not females (p=0.12) (Table 1, Table A4). The Spearhead localities' baseline performance in 2008/9 was significantly higher for females (p<0.01), but not for males (p=0.45) (Table 1, Table A4).

CO-verified quits

Changes experienced by Spearhead localities were not significantly different to that in non-Spearhead localities, in terms of CO-verified quits per 1,000 adult population (Table 1, Table A5) and CO-verified quits as a percentage of self-reported quits (Table 1, Table A8).

Quit rates

The experience of change in 'quit rate' performance of Spearhead and non-Spearhead localities was similar, whether measured as self-reported four-week quits as a percentage of enrolled smokers (Table 1, Figure A1, and Table A6) or CO-verified quits (Table 1 and Table A7). Spearhead localities had comparatively lower self-reported quit rates (Figure A1, Table A6).

Quit targets

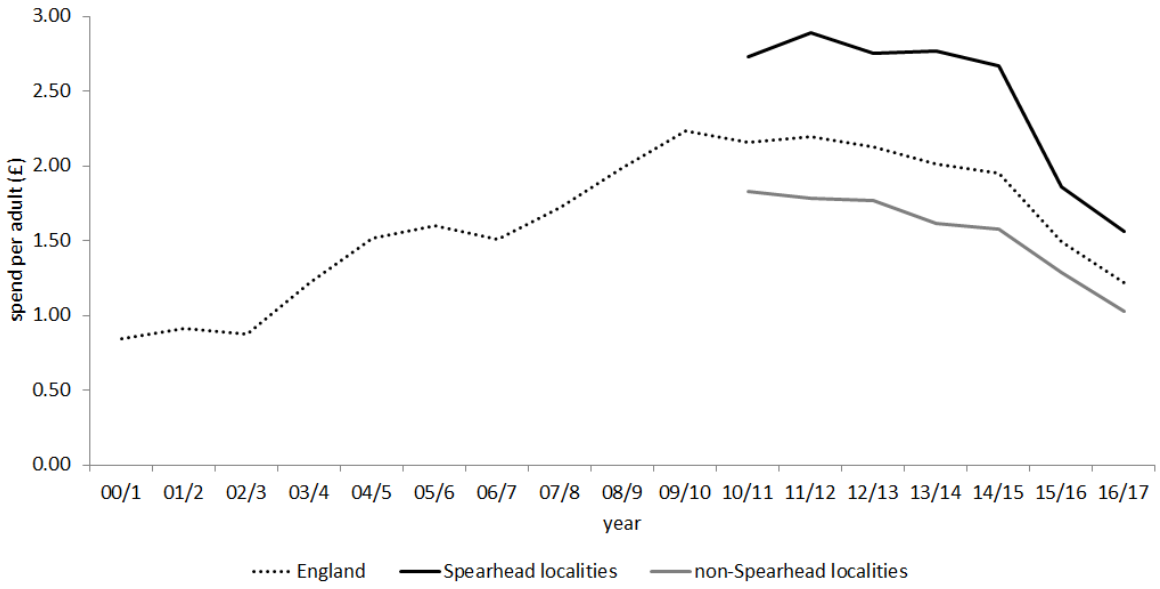
In the first years of SSS, the Department of Health set national targets for the number of self-reported quits at four weeks: in 2001/02, there were 65,000 quits against a target of 40,000 and over the three years to 2005/6 there were 833,000 quits and a target of 800,000.[10] In December 2009, the Department of Health advocated a range of interventions to address the health inequalities gap, including 'Smoking cessation clinics: double capacity in Spearhead areas for 2 years'.[33 p31] Using the number of smokers enrolled per 1,000 adult population in 2009/10 as the baseline for this stated change in capacity, this measure increased from 22.5 in Spearhead localities to 23.6 in 2010/11 and 24.3 in 2011/12 before declining in subsequent years (Figure 1).

Expenditure

Annual national expenditure on SSS per adult head of population increased from 2000/1 to 2009/10, and subsequently reduced (Figure 2). The growth in national expenditure was particularly marked in two periods; increasing by 74% over the two years to 2004/5, and by 48% over the three years to 2009/10. In Spearhead localities, for which expenditure estimates are uncertain for 2009/10, it is likely that expenditure peaked in 2011/12, when £45.8m was used along with approximately £33.5m in pharmacotherapies issued as part of the services (Table 2). Including the estimate of expenditure on pharmacotherapies, the total expenditure in Spearhead localities was about £38.9m in 2016/17, 51% (£40.8m) lower than its peak in 2011/12 (Table 2). The annual cost per self-reported quit at four weeks is shown in Figure A2.

If doubling the capacity of SSS for two years, as indicated by the Department of Health in 2009, was equated to doubling the expenditure in Spearhead localities from 2009/10, then an increase in funding of £152.3m would have been required over the two years to 2011/12.

Figure 2 Expenditure on Stop Smoking Services per adult head of population in 2016/17 prices [a]



[a] localities include those which reported cost data

Table 2 Estimated expenditure on stop smoking services and pharmacotherapies, Spearhead and non-Spearhead localities, 2009/10 to 2016/17

year	estimated expenditure on stop smoking services (£ millions)			estimated expenditure on pharmacotherapies[a] (£ millions)			Total: stop smoking services and pharmacotherapies[b] (£ millions)			% change from 2011/12		
	Spear	non-S	total	Spear	non-S	total	Spear	non-S	total	Spear	non-S	total
2009/10	43.8	50.6	94.4	33.1	38.3	71.4	76.9	88.9	165.8	-2.9	5.5	1.4
2010/11	42.8	49.4	92.2	33.4	38.6	72.0	76.2	88.0	164.1	-3.9	4.4	0.4
2011/12	45.8	48.7	94.4	33.5	35.6	69.1	79.2	84.3	163.5	0	0	0
2012/13	43.8	48.5	92.3	29.0	32.2	61.2	72.8	80.7	153.4	-8.2	-4.2	-6.1
2013/14	44.3	44.7	87.8	25.6	25.8	50.7	69.8	70.5	138.6	-11.8	-16.3	-15.2
2014/15	43.0	44.0	86.0	19.7	20.1	39.3	62.6	64.1	125.3	-21.0	-24.0	-23.4
2015/16	30.2	36.2	66.4	15.4	18.5	33.8	45.6	54.7	100.2	-42.5	-35.1	-38.7
2016/17	25.6	29.2	54.5	13.4	15.3	28.5	38.9	44.5	83.0	-50.9	-47.2	-49.2

[a] For those localities which reported SSS activity but no cost data, the SSS cost was estimated using the average cost per head of adult population for Spearhead and non-Spearhead localities.

[b] Nicotine Replacement Therapy, Bupropion (Zyban) and Varenicline (Champix). See methods section for estimation process.

Discussion

Main finding of this study

After similar increases in enrolment and quits between Spearhead and other localities between 2003/4 and 2008/9, SSS in Spearhead localities experienced a twofold better rate of improvement in enrolment and quit performance compared to other localities over the four years from 2008/9 to 2011/12. This comparative improvement was mainly for males rather than females. Since 2011/12, enrolment to SSS has dramatically reduced. Expenditure on these services has fallen by half in Spearhead localities between 2011/12 and 2016/17, and this change is particularly evident since 2014/15.

What is already known on this topic

Smoking

The prevalence of smoking in England is reducing over time; from 26.8% of the adult population in 2000 to 14.9% (6.1m) in 2017.[34] The overall success rate for smoking cessation has increased since 2011.[35] Smoking remains associated with socioeconomic status, with 10% of those on managerial and professional occupations smoking, compared to 26% of routine and manual workers and 29% of those unemployed in 2015.[36,37]

Stop smoking services

Bauld et al[38] assessed SSS in Spearhead localities over the three years to 2005/6, and concluded that its impact on reducing inequalities was likely to be small. They called for increased funding for expansion in order to 'maximise the potential contribution' of SSS, and highlighted its importance for achieving quits in areas of deprivation in comparison to other interventions, such as brief general practitioner (GP) advice, which may have less impact in Spearhead areas.[38]

However, by 2008 only 6.2% of smokers had used SSS when trying to quit: 4.6% (71/1552) from lower social grades D and E, and 6.9% (152/2215) from grades AB, C1 and C2.[39] The most common aid used by about 30% of those attempting to quit has been to purchase NRT (rather than have it prescribed).[40,41] However, since 2013, e-cigarettes have superseded purchased NRT as the most common aid for quitting.[41,36] This role for e-cigarettes has proved challenging for the Department of Health and Public Health England, leading to inevitable variation in local service provision responses.[17,42,41] McNeill et al argued that 'the combination of EC [e-cigarettes] with support from Stop Smoking Services is likely to optimise chances of stopping smoking' and should be available to all smokers.[41]

Limited use of SSS occurred despite economic evidence that SSS 'provide highly cost-effective interventions to help people stop smoking'[11], even though these interventions are associated with high smoking relapse rates.[37,43]. SSS have been characterised by local variation in performance.[12] The introduction of a pay-for-outcome scheme in one region to promote a greater focus on achieving quits was promising,[44] but not pursued after the move of commissioning responsibility to local authorities in 2013.[45]

Commissioning and funding

The New Labour Government's funding of SSS from 1999 was a key element of its ambitious and unprecedented strategy to address health inequalities in England.[46] However, the strategy was not pursued by the Coalition Government from 2010, and as part of the wholesale structural change to the NHS introduced in 2013, commissioning responsibility for SSS transferred from PCTs to public health teams in local authorities.[47] Subsequent budgetary pressure has contributed to reductions in funding of SSS.[47,48] By 2016, some local authorities were reported to have stopped commissioning SSS, and in a fifth of local authorities they had been 'replaced by an integrated 'lifestyle' service of some kind'.[42] McNeill et al concluded that '[w]ithout a specialist component, these services can be expected to be less effective in helping smokers quit'.[41,49]

The 2018 *Tobacco Control Delivery Plan* endorses SSS, noting that Public Health England and NHS England will '[c]ontinue to monitor effectiveness of stop smoking services and support local authorities to refocus support to quit'.[18] Furthermore, under the heading 'eliminating health inequalities through targeting those populations where smoking rates remain high', local authorities with high smoking prevalence are required to develop action plans to reduce tobacco-related health inequalities - but there are no locality-specific targets for enrolment or quits.[18]

The health inequalities gap

Although greater emphasis was placed on developing interventions to reduce the health inequalities gap in Spearhead localities from 2006, evidence of desired impact was not found by 2010.[6] However, comparing Spearhead and non-Spearhead local authorities, Barr et al[6] found that the gap in life expectancy for men increased between 1983 and 1998, when the upward trend stopped, and this was followed by a reduction in the gap between 2007 and 2013.[6 figure A2] Barr et al found that women experienced similar trends, but less change in the gap, which were not significant after 2003.[6 table A12] Barr et al also identified a 'Spearhead effect': significant increases in life expectancy for males and females in Spearhead localities compared to other localities after 2005, of 2.8 and 3.1 months, respectively, having adjusted for differential trends in deprivation.[6]

What this study adds

This study quantifies the performance of SSS in Spearhead localities compared to other localities in England during and after the implementation of the national health inequalities strategy. The Government declared in 2009 that its modelling indicated that smoking cessation would 'have a rapid impact on life expectancy in Spearhead areas, if they are done systematically and at sufficient scale'.[33] However, in 2010 the National Audit Office reported that interventions to reduce the gap in life expectancy, including doubling the capacity of SSS from 2007, were not being delivered on the required scale.[7,33] This study shows that although SSS were not expanded to the intended extent, they were delivered on an unprecedented scale particularly during the four years to 2011/12, and that this broadly coincides with the reduction in health inequality gap found by Barr et al.[6] This finding suggests that SSS may have had an important impact, which warrants recognition in light of current Government policy wishing to see local attention paid to addressing health inequalities.

At the same time, it could be argued that SSS have never been delivered at sufficient scale to have remotely fulfilled their potential to impact on health inequalities. As only about 5% of smokers in Spearhead localities engage with SSS when trying to quit, new service models are certainly needed, which, for example, support smokers over a longer intervention period to minimise relapse rates, and fully utilise aids such as e-cigarettes. In this context, perhaps the Government could be viewed as prudent to leave this difficult agenda to local authorities. To be sure, SSS are not optimal, but national leadership is essential to prioritise their development and secure systematic delivery on a scale envisaged a decade ago but not yet seen. This study's findings on SSS, alongside Barr et al's insight into changes in health inequalities, suggest the current demise of these services should not be tolerated.

Limitations of this study

Changing geographical boundaries for the collection and reporting of SSS data over time required mapping to 138 localities, which resulted in potential dilution of estimates of the comparative performance of Spearhead localities. The analysis is also constrained by the restricted reporting of SSS data, particularly before 2008/9. Data on CO-verified quits were first published in 2008/9, and the estimated quits per 1,000 adult population measure, which adjusted for over-reporting of self-reported quits not verified by CO testing, confirmed the self-reported quit findings. Data on outcomes are also limited to four-week quits, and although collecting 52-week data was first considered in 2001, the short-term focus on four weeks has inhibited both outcome assessment and

intervention development.[22] National efforts to promote high quality data are viewed as having been followed "in the main".[24,23] Nevertheless, the reporting of activity data could be influenced by service providers' payment incentives.[50, 44] Furthermore, as noted above, since 2013/14 some local authorities have failed to provide expenditure data for the national returns, and the 2016/17 dataset includes additional information about local service delivery issues and data quality. The comparison of performance of SSS in Spearhead and non-Spearhead localities enables assessment of whether the development over time of SSS in Spearhead localities, which was a focus of the health inequalities strategy, differed from that in the rest of England. The comparison is not between populations with similar characteristics; Spearhead populations were comparatively deprived with lower life expectancy and higher smoking prevalence.

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Appendix

Table A1 Number of localities for which SSS expenditure data are missing by year

localities	number	Number of localities for which data are missing by year			
		2013/14	2014/15	2015/16	2016/17
Spearhead	59	7	8	12	12
non-Spearhead	79	3	4	17	19

Estimated number of quits measure

Self-reported quits and CO-verified quits measure are not ideal for assessing changes in quit performance; self-reported quits overstate the number of smokers quitting because some are found to be invalid following CO testing, and changes in CO-verified quits may reflect changes in CO verification activity rather than changes in quit performance. In response to these issues, the estimated number of quits measure used here has been calculated by adjusting for the over-reporting of self-reported quits. The number of self-reported quits in each locality that were not confirmed by CO testing have been reduced by gender-specific proportions of quits, on the basis of the most recently published national data on the number of self-reported quits tested for CO verification,[22] for 2008/9, which indicate that 15.3% (19,424/126,838) of self-reported quits by men and 16.5% (23,131/139,995) of self-reports quits by women were found to have a CO reading of more than 10ppm, and therefore were not deemed to be valid. This assumption therefore makes appropriate use of both available published datasets on four-week quits by combining CO-verified quits and adjusted self-reported quits.

Figure A1 Four-week self-reported quits as percentage of enrolled smokers

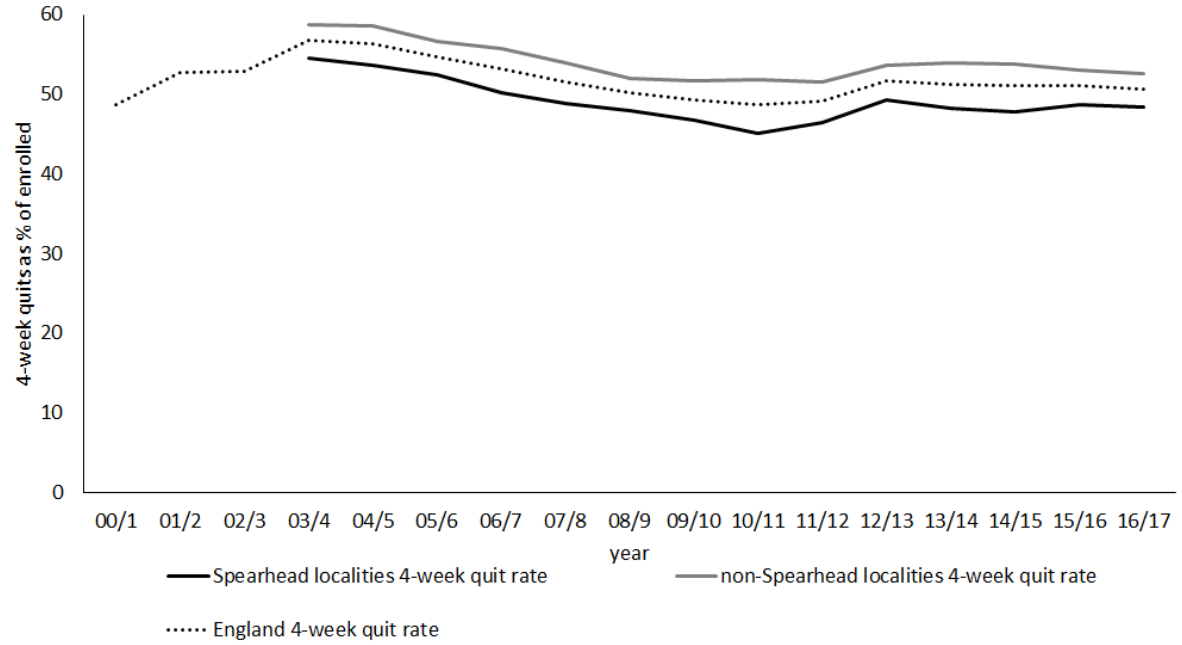
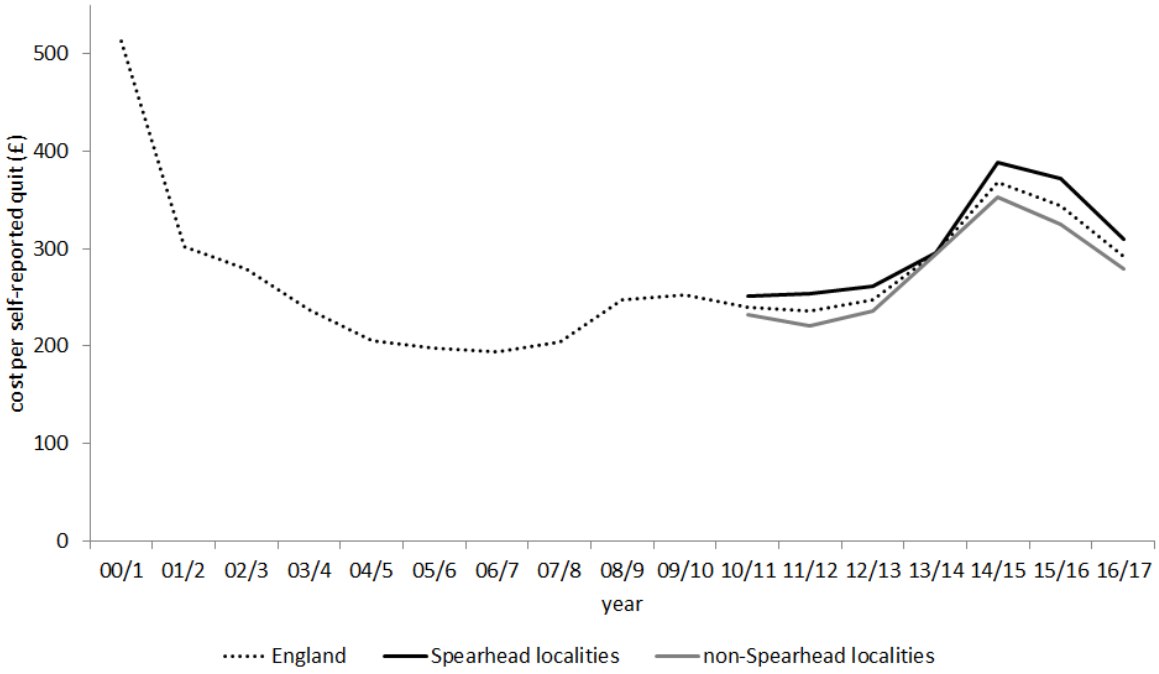


Figure A2 Cost per self-reported quit at 4 weeks in 2016/17 prices



Model results

Between 2003/4 and 2011/12, the Spearhead localities experienced an increase in the number of enrolled smokers per 1,000 adult population of 7.5% per year on average compared to an increase of 6.4% per year in the non-Spearhead localities (Table A2; 7.5% = ((1.064*1.011)-1)*100). This difference, expressed as a ratio of rates (i.e. the interaction term) was not statistically significant (1.011 = 1.075/0.064, p=0.118, 95% CI 0.997 to 1.024) (Table A2). The Spearhead localities' baseline enrolment per 1,000 adult population was significantly higher than that of the non-Spearhead localities (1.436, p<0.001, 95% CI 1.305 to 1.580) (Table A2).

The number of observations in each model are as follows: 2003/4 to 2011/12, 1242; 2011/12 to 2016/17, 798; 2003/4 to 2008/9, 828; 2008/9 to 2011/12, 552.

Table A2 Spearhead and non-Spearhead localities, changes over time in smokers enrolled in SSS per 1,000 adult population: model findings

period	all persons			males			females		
	IRR	P value	95% IC	IRR	P value	95% CI	IRR	P value	95% CI
2003/4 to 2011/12 [b]									
Spearhead	1.436	<0.001	1.305 to 1.580						
year	1.064	<0.001	1.055 to 1.073						
Spearhead.year	1.011	0.118	0.997 to 1.024						
constant	0.010	<0.001	0.010 to 0.011						
2011/12 to 2016/17 [a]									
Spearhead	1.797	<0.001	1.364 to 2.367	1.688	<0.001	1.277 to 2.232	1.901	<0.001	1.439 to 2.511
year	0.826	<0.001	0.812 to 0.841	0.822	<0.001	0.807 to 0.838	0.829	<0.001	0.815 to 0.843
Spearhead.year	0.982	0.179	0.956 to 1.008	0.984	0.267	0.957 to 1.012	0.980	0.118	0.954 to 1.005
constant	0.074	<0.001	0.062 to 0.089	0.077	<0.001	0.064 to 0.092	0.072	<0.001	0.060 to 0.087
2003/4 to 2008/9 [b]									
Spearhead	1.460	<0.001	1.310 to 1.627						
year	1.098	<0.001	1.080 to 1.115						
Spearhead.year	1.003	0.791	0.979 to 1.028						
constant	0.009	<0.001	0.009 to 0.010						
2008/9 to 2011/12									
Spearhead	1.228	<0.001	1.039 to 1.451	1.143	0.125	0.964 to 1.355	1.315	0.002	1.110 to 1.558
year	1.031	<0.001	1.015 to 1.047	1.031	<0.001	1.014 to 1.047	1.031	<0.001	1.015 to 1.047
Spearhead.year	1.034	0.006	1.010 to 1.060	1.038	0.003	1.013 to 1.063	1.030	0.015	1.006 to 1.056
constant	0.012	<0.001	0.011 to 0.014	0.012	<0.001	0.011 to 0.014	0.012	<0.001	0.011 to 0.014

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis

[b] gender-specific data for this measure were not published at locality-level before 2008/9

Table A3 new Spearhead and non-Spearhead localities, changes over time in self-reported quits per 1,000 adult population: model findings

period	all persons			males			females		
	IRR	P value	95% IC	IRR	P value	95% CI	IRR	P value	95% CI
2003/4 to 2011/12 [b]									
Spearhead	1.354	<0.001	1.241 to 1.477						
year	1.049	<0.001	1.040 to 1.057						
Spearhead.year	1.002	0.724	0.990 to 1.015						
constant	0.006	<0.001	0.006 to 0.006						
2011/12 to 2016/17 [a]									
Spearhead	1.545	<0.001	1.162 to 2.054	1.446	0.013	1.081 to 1.933	1.645	0.001	1.240 to 2.184
year	0.822	<0.001	0.806 to 0.839	0.819	<0.001	0.802 to 0.838	0.825	<0.001	0.809 to 0.841
Spearhead.year	0.989	0.476	0.959 to 1.020	0.992	0.611	0.961 to 1.024	0.986	0.357	0.957 to 1.016
constant	0.041	<0.001	0.034 to 0.050	0.044	<0.001	0.036 to 0.053	0.039	<0.001	0.032 to 0.047
2003/4 to 2008/9 [b]									
Spearhead	1.380	<0.001	1.254 to 1.519						
year	1.075	<0.001	1.060 to 1.091						
Spearhead.year	0.994	0.611	0.972 to 1.017						
constant	0.006	<0.001	0.005 to 0.006						
2008/9 to 2011/12									
Spearhead	1.163	<0.001	0.978 to 1.382	1.071	0.443	0.898 to 1.278	1.266	0.007	1.065 to 1.504
year	1.033	<0.001	1.017 to 1.050	1.034	<0.001	1.017 to 1.052	1.033	<0.001	1.016 to 1.050
Spearhead.year	1.026	0.046	1.000 to 1.051	1.020	0.021	1.005 to 1.057	1.020	0.118	0.995 to 1.045
constant	0.006	<0.001	0.006 to 0.007	0.006	<0.001	0.006 to 0.007	0.006	<0.001	0.005 to 0.007

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis

[b] gender-specific data for this measure were not published at locality-level before 2008/9

Table A4 Spearhead and non-Spearhead localities, changes over time in estimated quits per 1,000 adult population: model findings

period	all persons			males			females		
	IRR	P value	95% IC	IRR	P value	95% CI	IRR	P value	95% CI
2008/9 to 2011/12									
Spearhead	1.158	<0.001	0.974 to 1.276	1.068	0.447	0.895 to 1.274	1.261	0.008	1.062 to 1.498
year	1.036	<0.001	1.020 to 1.053	1.038	<0.001	1.021 to 1.055	1.036	<0.001	1.020 to 1.053
Spearhead.year	1.026	0.047	1.000 to 1.051	1.030	0.022	1.004 to 1.057	1.020	0.118	0.995 to 1.045
constant	0.006	<0.001	0.005 to 0.007	0.006	<0.001	0.005 to 0.007	0.006	<0.001	0.005 to 0.006
2011/12 to 2016/17[a]									
Spearhead	1.524	<0.001	1.153 to 2.014	1.425	0.015	1.071 to 1.896	1.622	0.001	1.230 to 2.139
year	0.822	<0.001	0.806 to 0.838	0.818	<0.001	0.802 to 0.835	0.825	<0.001	0.809 to 0.840
Spearhead.year	0.990	0.518	0.961 to 1.020	0.993	0.663	0.962 to 1.025	0.987	0.391	0.959 to 0.045
constant	0.039	<0.001	0.033 to 0.047	0.042	<0.001	0.035 to 0.050	0.037	<0.001	0.031 to 0.045

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis

Table A5 Spearhead and non-Spearhead localities, changes over time in CO-verified quits per 1,000 adult population: model findings

period	all persons			males			females		
	IRR	P value	95% IC	IRR	P value	95% CI	IRR	P value	95% CI
2008/9 to 2011/12									
Spearhead	1.090	<0.001	0.808 to 1.469	1.000	0.999	0.743 to 1.347	1.197	0.233	0.891 to 1.608
year	1.065	<0.001	1.039 to 1.091	1.067	<0.001	1.040 to 1.094	1.063	<0.001	1.037 to 1.088
Spearhead.year	1.030	0.124	0.992 to 1.069	1.035	0.079	0.996 to 1.075	1.023	0.226	0.986 to 1.061
constant	0.003	<0.001	0.003 to 0.004	0.004	<0.001	0.003 to 0.004	0.003	<0.001	0.003 to 0.004
2011/12 to 2016/17[a]									
Spearhead	1.372	<0.001	0.974 to 1.932	1.259	0.198	0.887 to 1.788	1.471	0.023	1.054 to 2.052
year	0.822	<0.001	0.804 to 0.840	0.819	<0.001	0.801 to 1.038	0.823	<0.001	0.806 to 0.841
Spearhead.year	0.998	0.898	0.966 to 1.031	1.003	0.873	0.024 to 0.038	0.994	0.713	0.963 to 1.026
constant	0.029	<0.001	0.023 to 0.036	0.030	<0.001	0.024 to 0.038	0.027	<0.001	0.022 to 0.034

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis

Table A6 Spearhead and non-Spearhead localities, changes over time in self-reported quits as a percentage of enrolled smokers: model findings

period	all persons			males			females		
	IRR	P value	95% IC	IRR	P value	95% CI	IRR	P value	95% CI
2003/4 to 2011/12 [b]									
Spearhead	0.944	0.030	0.895 to 0.994						
year	0.984	<0.001	0.979 to 0.990						
Spearhead.year	0.991	0.042	0.983 to 0.9997						
constant	0.576	<0.001	0.556 to 0.596						
2011/12 to 2016/17[a]									
Spearhead	0.868	0.031	0.763 to 0.987	0.854	0.011	0.757 to 0.964	0.873	0.036	0.768 to 0.991
year	0.995	0.293	0.987 to 1.004	0.995	0.180	0.987 to 1.003	0.996	0.324	0.988 to 1.004
Spearhead.year	1.006	0.330	0.994 to 1.019	1.008	0.203	0.996 to 1.020	1.006	0.351	0.993 to 1.019
constant	0.552	<0.001	0.507 to 0.601	0.572	<0.001	0.528 to 0.619	0.538	<0.001	0.495 to 0.585
2003/4 to 2008/9 [b]									
Spearhead	0.949	0.052	0.900 to 1.000						
year	0.977	<0.001	0.969 to 0.986						
Spearhead.year	0.990	0.121	0.977 to 1.003						
constant	0.586	<0.001	0.566 to 0.607						
2008/9 to 2011/12									
Spearhead	0.951	0.405	0.845 to 1.070	0.940	0.287	0.839 to 1.053	0.965	0.538	0.862 to 1.080
year	1.003	0.569	0.993 to 1.013	1.004	0.490	0.994 to 1.014	1.002	0.739	0.992 to 1.012
Spearhead.year	0.991	0.262	0.976 to 1.007	0.993	0.341	0.978 to 1.008	0.989	0.159	0.975 to 1.004
constant	0.506	<0.001	0.469 to 0.547	0.516	<0.001	0.479 to 0.556	0.500	<0.001	0.464 to 0.538

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis

[b] gender-specific data for this measure were not published at locality-level before 2008/9

Table A7 Spearhead and non-Spearhead localities, changes over time in CO-verified quits as a percentage of enrolled smokers: model findings

period	all persons			males			females		
	IRR	P value	95% IC	IRR	P value	95% CI	IRR	P value	95% CI
2008/9 to 2011/12									
Spearhead	0.893	0.435	0.672 to 1.187	0.877	0.358	0.663 to 1.160	0.914	0.519	0.695 to 1.202
year	1.034	0.003	1.012 to 1.055	1.035	0.001	1.014 to 1.056	1.030	0.003	1.010 to 1.051
Spearhead.year	0.995	0.744	0.964 to 1.027	0.997	0.849	0.966 to 1.029	0.992	0.610	0.962 to 1.023
constant	0.278	<0.001	0.231 to 0.335	0.282	<0.001	0.235 to 0.339	0.277	<0.001	0.232 to 0.332
2011/12 to 2016/17[a]									
Spearhead	0.771	0.062	0.587 to 1.014	1.280	0.160	0.907 to 1.807	1.474	0.019	1.067 to 2.037
year	0.998	0.779	0.984 to 1.012	0.822	<0.001	0.805 to 0.840	0.826	<0.001	0.810 to 0.842
Spearhead.year	1.017	0.124	0.995 to 1.039	1.002	0.883	0.970 to 1.036	0.995	0.753	0.966 to 1.025
constant	0.375	<0.001	0.314 to 0.449	0.029	<0.001	0.023 to 0.037	0.027	<0.001	0.022 to 0.033

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis

Table A8 Spearhead and non-Spearhead localities, changes over time in CO-verified quits as a percentage of self-reported quits: model findings

period	all persons			males			females		
	IRR	P value	95% IC	IRR	P value	95% CI	IRR	P value	95% CI
2008/9 to 2011/12									
Spearhead	0.945	0.652	0.740 to 1.207	0.941	0.615	0.741 to 1.194	0.955	0.703	0.756 to 1.207
year	1.030	0.001	1.012 to 1.050	1.031	0.001	1.013 to 1.050	1.028	0.002	1.010 to 1.047
Spearhead.year	1.003	0.843	0.975 to 1.031	1.003	0.825	0.976 to 1.031	1.001	0.917	0.975 to 1.029
constant	0.550	<0.001	0.469 to 0.645	0.548	<0.001	0.468 to 0.640	0.557	<0.001	0.478 to 0.649
2011/12 to 2016/17[a]									
Spearhead	0.885	0.384	0.673 to 1.165	0.873	0.320	0.669 to 1.140	0.880	0.335	0.679 to 1.141
year	1.002	0.774	0.988 to 1.016	1.003	0.722	0.989 to 1.016	0.999	0.903	0.986 to 1.013
Spearhead.year	1.010	0.338	0.989 to 1.033	1.012	0.255	0.991 to 1.034	1.011	0.296	0.991 to 1.032
constant	0.684	<0.001	0.571 to 0.818	0.684	<0.001	0.574 to 0.816	0.699	<0.001	0.590 to 0.828

[a] 5 localities did not report SSS activity during one or more years during this period and were omitted from the analysis